General Training On Methodologies For Geological Disposal in North America

IAEA Network of Centers of Excellence

Performance Standards for Geologic Disposal: A Regulator's Perspective

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Performance Standards for Geologic Disposal: A Regulator's Perspective

- Process for establishing regulations
  - Background and goals
  - The steps in the process
- Major elements in performance standards
- A case study: EPA's standards for geologic disposal of radioactive waste (40 CFR 191)

Regulatory Process: Background

- The development of U.S. standards is defined by
  - Legislative requirements
  - Policies of the regulatory agency
- Goals
  - Public information and involvement
  - Openness, no undue influence
  - Clear explanation and basis for regulations
- Failure to follow the process can lead to
  - Loss of public confidence
  - Implementation problems
  - Legal vulnerability
- No standard time frame for rule development

Regulatory Process: How It Works

- Information gathering
- Proposed rule
- Public input, refine approach
- Final rule

- At each stage, there are different goals and requirements.

Regulatory Process - Step 1: Information Gathering

- Serves as basis to develop technical criteria and regulatory approach
- Flexibility in methods is allowed and helpful
- Possible sources of information include
  - Internal research
  - Consultation with stakeholders
  - International cooperation and consultation
  - Independent reviews (U.S. National Academy of Sciences)
  - Announcement of intent to develop rule (optional)

Regulatory Process - Step 2: Proposed Rule

- "Proposed rule" explains reasoning
- Written notice required, other informal mechanisms available (mailing lists, etc.)
- Must explain reasoning
  - Technical and policy considerations
  - Multiple options may be discussed
  - Supporting documents are made available
  - Specific issues may be highlighted for input

Regulatory Process - Step 3: Public Input

- Equal information, access is crucial
  - Public hearings and meetings may be targeted (but not restricted) to certain stakeholders
  - Written comments can be submitted
  - Interaction with stakeholders in private is limited
- Internal consideration of input is crucial in developing, defending final rule
- Additional information gathering may occur (further internal research, consultation)

Regulatory Process - Step 4: Final Rule

- Written notice required (other methods optional)
- Must provide final standards and explanation
  - Discussion of major comments, how considered
  - Rationale for final standards
  - Must be "logical outgrowth" of proposal, no completely new issues
  - Effective date and other legal aspects
  - Guidance, expectations for implementation can be provided
- Administrative reviews are also required to ensure consistency within and across Agencies

Major Elements in Safety Standards for Geologic Disposal

- Baseline Conditions: source term, site conditions
- Time frame of analysis
- Events/scenarios to be considered
  - Exposure pathways of interest
  - Exclusion of "unlikely" events, combination of events
  - Human intrusion
- Receptor location and characteristics
  - Receptor location or "compliance boundary"
  - Individual or group receptors
  - Assumptions on ultimate land use and accessibility
  - Activity, rates of consumption
  - Non-human or environmental receptors

Elements in Safety Standards for Geologic Disposal (cont)

- Treatment of parameter uncertainty
  - Average
  - Worst case
  - Probabilistic analysis
- Form of results: risk, dose, concentration
- Required level of confidence
- Other
  - Quality assurance on data
  - Peer review
  - Model validation
  - Qualitative measures, sub-system performance
- Multiple compliance measures may apply with different time frames, scenarios, etc.

Challenges for Regulating Geologic Disposal

- Source term may be uncertain or non-homogeneous
  - Radioactive decay
- Very long time frames -- significant implications for defining receptors and bounding uncertainty
  - Uncertainty in land use, institutional controls
  - Human intrusion scenarios
  - Evolution of natural processes
  - Definition of unlikely events
  - Demographic or behavioral patterns
- Challenges to verifying results
- Much different approach than regulation of other hazardous materials

Case Study: EPA's Generic Standards for High-Level and Transuranic Waste (40 CFR 191)

- Apply to all disposal systems for high-level and transuranic waste
  - Applies to WIPP (with EPA as implementing agency)
  - Yucca Mountain exempt (site-specific standards)
- Limit individual annual doses from operations
- For disposal phase, three primary compliance measures
  - Release limits (cumulative curies)
  - Individual dose limits (annual)
  - Ground water concentration limits

Case Study: 40 CFR 191 Disposal Standards

- Regulatory time frame is 10,000 years
- All release and exposure pathways are considered
- Scenarios
  - "Significant" events included; "unlikely" events excluded
  - Human intrusion assessed for release limits only
- Receptor
  - Surrounding geologic media part of containment system ("controlled area")
  - Compliance measured at limits of institutional control
  - Special protections for ground water

Case Study: 40 CFR 191 Disposal Standards

- Treatment of uncertainty
  - Probabilistic performance assessment
  - "Reasonable expectation" of compliance: "Proof of the future performance of a disposal system is not to be had in the ordinary sense of the word."
- Compliance limits
  - Two compliance points for release limits
    - Limits proportional to inventory of nuclides
    - Small chance (0.1) of exceeding limits (normalized)
    - Very small chance of greatly exceeding limits (0.001, 10 times normalized limits)
    - Includes consideration of human intrusion
  - Individual protection: 15 mrem/yr (undisturbed)
  - Ground water protection: equivalent to present-day drinking water limits (undisturbed)

Case Study: - 40 CFR 191 Disposal Standards

- Assurance Requirements
  - Active institutional controls (no credit after 100 years)
  - Monitoring (without disruption of disposal system)
  - Passive institutional controls and markers
  - Engineered barriers
  - Avoidance of resource-rich areas
  - Retrieval of wastes not precluded
- Significant details are left to licensing agency
  - Definition of "unlikely" and "significant" events
  - Selection of statistical measures and confidence
  - Key assumptions on scenarios, receptor characteristics, social and demographic changes
  - Quality assurance, peer review, parameter estimation

Key Lessons

- Must pay attention to process and end result
  - Public confidence depends on both
  - Legal challenges (in U.S.) can be based on either aspect
- National and international views evolve
    - Keep in mind that the framework as a whole must be protective and credible
  - Balance two competing demands
    - Make goals and compliance measures as straightforward and understandable as possible…
    - While leaving adequate flexibility to accommodate evolving priorities and unanticipated issues
- More detailed licensing criteria – based on the safety standards – are necessary for effective implementation
  - Allows greater flexibility in underlying standards (as discussed above)
  - Later decisions are not less important–but more detailed and site-specific
- Continuing dialogue and evaluation of regulations is essential
  - Open, public processes continue to be important or confidence can erode.